

DISCUSSION OF THE AMENDMENT

Claims 1-2, 5-24, and 27-28 are active in the present application. Claims 3-4 and 25-26 are canceled claims. Claims 27-28 are new claims. Support for new Claims 27 and 28 is found on page 17 of the specification. Independent Claim 1 is amended to state that the etching is carried out to a depth of about 1 μm . Support for the amendment is found in previously presented Claim 26. Claims 23 and 24 are amended for matters of form.

No new matter is added.

REMARKS

Applicants thank Examiner Arancibia for discussing this case with Applicants' U.S. representative on May 29, 2008. During the discussion it was pointed out that although there may be some similarities between the broad categories of cleaning a surface and etching a surface, etching to a depth of about 1 μm is different from surface cleaning.

The presently claimed method of reclaiming a silicon wafer comprises a heating/removal process that includes heating a silicon wafer at a temperature of 150-300°C and further comprises a chemical process that etches a top surface of the silicon wafer with a solution comprising an alkaline material. The etching is carried out to a depth of about 1 μm . Independent Claim 1 requires, in part:

...removing a surface part of the silicon wafer by etching the top surface of the silicon wafer with a solution comprising one or more of an alkaline hydroxide and an alkaline carbonate to a depth of about 1 μm .

As explicitly required by Claim 1, the etching of the claimed invention is carried out with an alkaline hydroxide or alkaline carbonate to a depth of about 1 μm .

The Office appears to be of the opinion that the prior art relied on in the Office Action of April 2, 2008 suggests including an alkaline component in the cleaning and/or etching steps disclosed in Chai, Falster, and Lawrence. Applicants traverse the rejection on the grounds that (i) combining the references relied on by the Office in the manner suggested by the Office does not disclose or suggest carrying out the etching of the claimed invention, and (ii) Applicants' original specification provides data demonstrating that carrying out etching with an alkaline solution provides a method that is able to substantially reduce the amount of Cu present in the silicon wafer in comparison to etching with other solutions.

The Office relies on Chai (US 5,837,662) as evidence that a chemical removal step can be performed using an alkaline hydroxide (see page 4, last paragraph of the April 4 Office Action). The Office asserts:

In the instant case, the teachings of Chai et al. would have suggested to one of ordinary skill in the art to include at least one of the alkaline hydroxides and/or alkaline carbonates taught by Chai et al. in the chemical removal process taught by Lawrence and Falster et al., for the reason as taught by Chai et al. of causing contaminants to be electrostatically repelled from the surface of the wafer. One of ordinary skill in the art would recognize that including such a bath aid could be useful even when a portion of the wafer is to be etched away, so as to provide a contaminant-free finished surface.

See page 9, lines 6-13 of the April 4 Office Action.

As argued in the Amendment filed on February 4, 2008, Chai discloses the use of an alkaline bath aid to change the surface potential of a silicon wafer, not to etch the silicon wafer. As already mentioned above, present Claim 1 requires etching the surface of the silicon wafer to a depth of about 1 μm with an alkaline material. Chai does not disclose carrying out etching with an alkaline material but instead discloses changing the surface potential of a silicon wafer with an alkaline solution. Changing the surface potential of a surface and etching a surface to a depth of about 1 μm are two different things. Thus, Chai does not disclose or suggest etching a surface using an alkaline component.

With regard to the Office's assertion that it would be obvious to include the alkaline bath aid of Chai in the chemical removal processes of Lawrence and/or Falster, Applicants submit that such a combination would not make sense because the result would be neutralization of the resulting bath solution (e.g., adding an alkaline component to an acidic solution transforms the alkaline component into a neutral salt). Lawrence discloses etching in column 6, lines 49-68. The etchants disclosed in Lawrence are acidic materials such as hydrofluoric acid, nitric acid, acetic acid, etc. with other materials such as oxidants in the

form of iodine. Including the alkaline bath aid of Chai in the etchant of Lawrence would make no sense because mixing an alkaline bath aid with any of the strong acids disclosed in Lawrence would yield a composition having no alkaline characteristics.

Falster discloses a number of cleaning solutions at column 4, lines 38-65. One of these cleaning solutions is an RCA SC-1 solution that may contain an alkaline material such as NH_4OH in water. The purpose of the RCA SC-1 solution is to remove organic contaminants and particles. The RCA SC-1 solution is not disclosed as useful for etching a silicon wafer to a depth of about 1 μm . In fact, Falster cautions against using the RCA SC-1 solutions for etching:

The wafers may be cleaned in an SC-1 solution for about 5 to about 30 minutes. If the wafers are immersed in the cleaning solution for a longer time, excessive etching, pitting and roughening can occur.

See column 4, lines 56-59 of Falster.

Thus, even where Falster discloses contacting a silicon wafer with an alkaline solution, such contacting is only for the purpose of surface cleaning and not for etching to a depth of about 1 μm . Falster also discloses the use of RCA SC-2 solutions, however, such solutions are acidic solutions and, for the reasons mentioned above for the combination of Chai with Lawrence, using an alkaline bath aid in a strong acidic solution would transform the alkaline bath aid to a neutral salt and thus provide a solution having no alkaline characteristics.

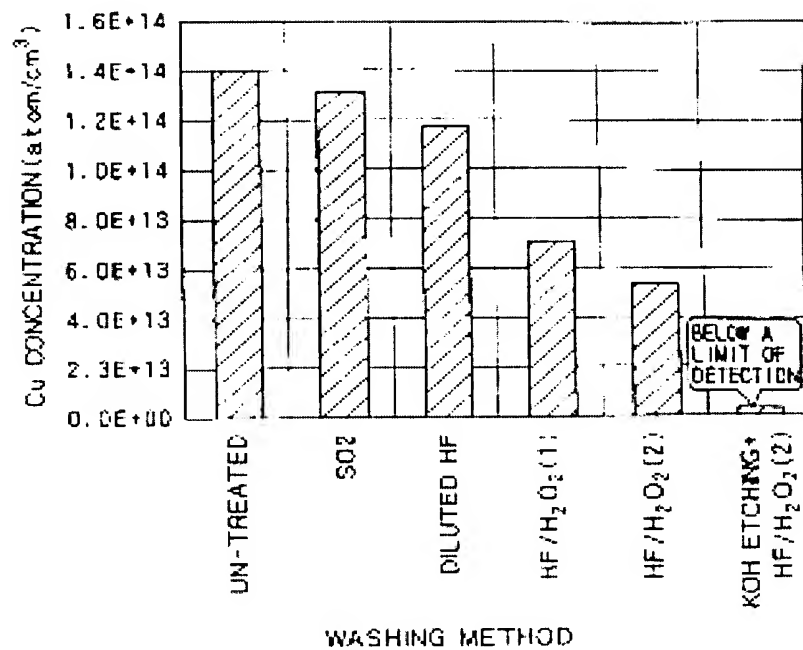
Therefore, combining the alkaline bath aid of Chai in the cleaning and/or etching steps of Falster and Lawrence would not lead one of ordinary skill in the art to carry out etching of a silicon wafer with an alkaline hydroxide and/or an alkaline carbonate such that the etching of the silicon surface occurs to a depth of about 1 μm . Including the alkaline bath aid of Chai in the etching and/or cleaning solutions of Falster and Lawrence would lead to a

solution having no alkaline characteristics and/or would not be capable of etching a silicon wafer surface.

Therefore, the subject matter of Claim 1 should be found patentable over the combination of Chai, Lawrence and/or Falster and the presently pending claims should be allowed.

Moreover, Applicants have shown in the original specification that carrying out etching with an alkaline solution, e.g., a KOH-containing solution, provides a means of reducing the copper concentration in silicon wafers by an amount that is substantially greater than the amount of Cu reduction that is achieved with other types of etching (e.g., with acid etching and/or oxidation using materials such as HF and H₂O₂). Applicants draw the Office's attention to page 17, lines 14-23 and Figure 3 of the original specification. Figure 3 shows that the amount of Cu that may be detected in a silicon wafer after being subjected to the heating/removal process of present Claim 1, is substantially less than the amount of Cu that is detected in a silicon wafer that is treated (e.g., reclaimed) using a process that carries out heating/removal with a solution other than an alkaline hydroxide and/or alkaline carbonate-containing. Figure 3 shows that when a silicon wafer is immersed in various solutions such as an SC-2 solution, an HF solution, an HF/H₂O₂ solution, etc., the silicon wafer has a measurable amount of Cu atoms present (see the second through the fifth bars of the chart provided as Figure 3 - reproduced below for convenience):

FIG. 3



In contrast, when the silicon wafer is treated with a process that includes heating/removal that comprises a chemical process of heating and subsequent etching using an alkaline solution to etch the silicon wafer surface to a depth of about 1 μm , the amount of Cu is below the detection limit (see the second full paragraph, last sentence, on page 17 of the specification).

Applicants have thus provided evidence in the form of examples in the original specification demonstrating that a method of reclaiming silicon wafers that includes a chemical process of etching a surface of the silicon wafer with an alkaline solution to a depth of about 1 μm provides a silicon wafer that has substantially reduced Cu concentration.

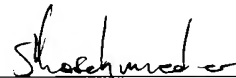
Among other things, this evidence shows that generic etching of a silicon surface does not provide a silicon surface having the substantially reduced Cu content that is provided when the silicon surface is etched according to the claimed invention to a depth of about 1 μm .

Applicants further draw the Office's attention to new dependent Claim 27 which requires that the alkaline etching is followed by a top surface cleaning with an HF/H₂O₂ solution.

For the reasons discussed above in detail, Applicants submit that all now-pending claims are in condition for allowance. Applicants request withdrawal of the rejection and the mailing of a Notice of Allowance acknowledging the patentability of the presently claimed subject matter.

Respectfully submitted,

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